

Amendments to the Specification:

At page 1, line 1, please replace the title of the invention with the following amended title:

“Motor Having Supply Brushes”

Please replace the paragraph beginning at page 1, line 22, with the following amended paragraph:

To eliminate the drawback, Japanese Laid-Open Patent Publication No. 2002-119031 discloses a motor with a brush that has high-resistance portions and a low-resistance portion. The high-resistance portions are provided at a part of the supply brush that first contacts a ~~commutator~~commutator segment and a part that lastly separates from the segment. The remainder of the supply brush is the low-resistance portion.

Please replace the paragraph beginning at page 3, line 26, with the following amended paragraph:

The present invention also provides another motor. The motor includes six magnetic poles, an armature, eight excitation coils, a commutator, a plurality of short-circuiting members and a plurality of supply brushes. The magnetic poles are arranged at equal angular intervals along a circumferential direction. Each adjacent pair of the magnetic poles has different magnetic properties. The armature has eight teeth, the teeth being arranged at equal angular intervals along a circumferential direction. Each of the excitation coils is wound about one of the teeth by way of concentrated winding. The commutator has twenty-four segments. Ends of each excitation coil are connected to corresponding ones of the segments. Each short-circuiting member connects two of the segments that are connected to the excitation coils and one of the segments that are not connected to the excitation coils to one another, such that two of the excitation coils that are arranged at a 135°

interval about the axis of the armature are simultaneously supplied with electricity. The segments in each group of short-circuited three segments are arranged at 120° intervals. The supply brushes are slidable on the segments. The supply brushes include first and second brushes at the same pole. The second brush has a higher electrical resistance than the first supply brush. The first and second supply brushes simultaneously contact the two segments in one of the sets of three segments that are connected to the corresponding excitation coils. The first and second brushes are arranged at an angular interval less than 120° , so that, when the first brush separates from the contacting segment, the second brush separates from the segment that is short-circuited with the segment from which the first brush has separated after a delay.

Please replace the paragraph beginning at page 4, line 24, with the following amended paragraph:

The present invention also provides another motor. The motor includes six magnetic poles, an armature, eight excitation coils, a commutator, a plurality of short-circuiting members and a plurality of supply brushes. The magnetic poles are arranged at equal angular intervals along a circumferential direction. Each adjacent pair of the magnetic poles has different magnetic properties. The armature has eight teeth. The teeth are arranged at equal angular intervals along a circumferential direction. Each of the excitation coils is wound about one of the teeth by way of concentrated winding. The commutator has twenty-four segments. Ends of each excitation coil are connected to corresponding ones of the segments. Each short-circuiting member connects two of the segments that are connected to the excitation coils and one of the segments that are not connected to the excitation coils to one another, such that two of the excitation coils that are arranged at a 135° interval about the axis of the armature are simultaneously supplied with electricity. The segments in each group of short-circuited three segments are arranged at 120° intervals. The supply brushes are slidable on the segments. The supply brushes include a first brush that supplies electricity to the segments and a second brush that does not supply

electricity to the segments. The first and second supply brushes simultaneously contact the two segments in one of the sets of three segments that are connected to the corresponding excitation coils. The first and second brushes are arranged at an angular interval less than 120° , so that, when the first brush separates from the contacting segment, the second brush separates from the segment that is short-circuited with the segment from which the first brush has separated after a delay.

Please replace the Brief Description of the Drawings section, which begins on page 5 line 35, with the following amended section:

BRIEF DESCRIPTION OF THE DRAWINGS

The invention, together with objects and advantages thereof, may best be understood by reference to the following description of the presently preferred embodiments together with the accompanying drawings which:

Fig. 1(a) is a schematic view illustrating a motor according to a first embodiment of the present invention;

Fig. 1(b) is an enlarged view illustrating the commutator of the motor shown in Fig. 1(a);

Fig. 2 is a ~~development~~developed diagram showing the wires and the commutator of the motor shown in Fig. 1(a);

Fig. 3 is a ~~development~~developed diagram showing the commutator;

Fig. 4 is a ~~development~~developed diagram showing a commutator according to a second embodiment;

Fig. 5 is a ~~development~~developed diagram showing a commutator according to a third embodiment;

Fig. 6 is a ~~development~~developed diagram showing a commutator according to a fourth embodiment;

Fig. 7 is a ~~development~~developed diagram showing a commutator according to a fifth embodiment;

Fig. 8 is a ~~development~~developed diagram showing a commutator according to a sixth embodiment;

Fig. 9 is a schematic view showing a motor according to a seventh embodiment;

Fig. 10 is a schematic view showing the motor of Fig. 9;

Fig. 11 is a circuit diagram of the motor shown in Fig. 9;

Fig. 12 is a diagram showing commutation;

Fig. 13 is a diagram showing commutation;

Fig. 14 is a schematic: view showing a motor according to an eighth embodiment; and

Fig. 15 is a ~~development~~developed diagram showing the wires of the motor shown in Fig. 14.

Please replace the paragraph beginning at page 8, line 5, with the following amended paragraph:

As shown in Figs. 2 and 3, each segment 55a is short-circuited with another predetermined one of the segments 55a with a short-circuit line 58. For example, the No. 16 segment 55a and the No. 8 segment 55a are short-circuited with a short-circuit line 58. The No. 1 segment 55a and the No. 9 segment 55a are short-circuited with a short-circuit line 58. The No. 2 segment 55a and the No. 10 segment 55a are short-circuited with a short-circuit line 58. That is, each pair of the segments 55a that are symmetrical with respect to the axis of the rotary shaft 53 are short-circuited with one of the short-circuit lines 58.

Please replace the paragraph beginning at page 8, line 17, with the following

amended paragraph:

The motor 51 includes a first main brush 59a, which is an anode, a second main brush 59b, which is a cathode, a first sub-brush 59c, which is an anode, and a second sub-brush 59d, which is a cathode. The four brushes 59a to 59d slide on the commutator 55. The brushes 59a to 59d are identical and the widths of the brushes 59a to 59d are the same as the width of each segment 55a. The first and second main brushes 59a, 59b have a low resistance. The first and second sub-brushes 59c, 59d have a high resistance. The first main brush 59a and the first sub-brush 59c form a first brush group. The second main brush 59b and the second sub-brush 59d form a second brush group. The first main brush 59a and the first ~~sub-brushes~~ sub-brush 59c each have an effective contacting width along the circumferential direction of the commutator 55, in which effective contacting width each supply brush contacts segments 55a. The effective contacting widths are the same as the circumferential width of the segments 55a. Also, the second main brush 59b and the second ~~sub-brushes~~ sub-brush 59d each have an effective contacting width along the circumferential direction of the commutator 55, in which effective contacting width each supply brush contacts segments 55a. The effective contacting widths are the same as the circumferential width of the segments 55a.

Please replace the paragraph beginning at page 11, line 16, with the following amended paragraph:

The brushes 60a to 60d are arranged at 90° intervals. Specifically, the first main brush 60a, which is an anode, is displaced from the second main brush 60b, which is a cathode, by 90° with respect to the rotation direction of the commutator 55. The first sub-brush 60c, which is an anode, is displaced from the first main brush 60a by a predetermined angle ($180^\circ + \theta_2$) with respect to the rotation direction. The second sub-brush 60d, which is a cathode, is displaced from the second main brush 60b by a predetermined angle ($180^\circ + \theta_2$) with respect to the rotation direction. The angle θ_2 corresponds to ~~the half~~ one-half of the width of each segment 55a (which, in this case, is the width of each of the brushes 60a to

60d) along the circumferential direction of the commutator 55.

Please replace the paragraph beginning at page 13, line 3, with the following amended paragraph:

A motor [[51]] of this embodiment has six permanent magnets M, and eight excitation coils 62a to 62h. The motor [[51]] has a commutator 63. Twenty-four commutator segments 63a are fixed to the circumferential surface of the commutator 63. Numerals 1 to 24 are given to the segments 63a in order along the circumferential direction of the commutator 63.

Please replace the paragraph beginning at page 14, line 25, with the following amended paragraph:

Electric current supplied from the main brush 65a is split into two. ~~One~~ A portion of the ~~currents~~ current is supplied to the fourth excitation coil 62d, which is spaced from the first excitation coil 62a by 135°, the seventh excitation coil 62g, which is spaced from the fourth excitation coil 62d by 135°, and the second excitation coil 62b, which is separated from the seventh excitation coil 62g by 135°. The other portion of the current is supplied to the third excitation coil 62c, which is spaced from the sixth excitation coil 62f by 135°, the eighth excitation coil 62h, which is spaced from the third excitation coil 62c by 135°, and the fifth excitation coil 62e, which is separated from the eighth excitation coil 62e by 135°.

Please replace the paragraph beginning at page 17, line 10, with the following amended paragraph:

The first main brush 66a, which is an anode, and the second main brush 66b, which is a cathode, are spaced apart by 180°. The first sub-brush 66c, which is an anode, is displaced from the first main brush 66a by a predetermined angle (120° - 144°) with respect to the direction opposite to the rotation direction. The second sub-

brush 66d, which is a cathode, is displaced from the second main brush 66b by a predetermined angle ($120^\circ - \theta_4$) with respect to the direction opposite to the rotation direction. The angle θ_4 corresponds to ~~the half~~ one-half of the width of each segment 63a (which, in this case, is the width of each of the brushes 60a to 60d) along the circumferential direction of the commutator 63.

Please replace the paragraph beginning at page 19, line 15, with the following amended paragraph:

The brushes 67a to 67f are arranged at 60° intervals. Specifically, the first main brush 67a, which is an anode, and the second main brush 67b, which is a cathode, are spaced apart by 180° . The first sub-brush 67c, which is an anode, is displaced from the first main brush 67a by a predetermined angle ($120^\circ - \theta_5$) with respect to the direction opposite to the rotation direction. The second sub-brush 67d, which is a cathode, is displaced from the second main brush 67b by a predetermined angle ($120^\circ - \theta_5$) with respect to the direction opposite to the rotation direction. The angle θ_5 corresponds to ~~the quarter~~ one-quarter of the width of each segment 63a (which, in this case, is the width of each of the brushes 67a to 67f) along the circumferential direction of the commutator 63.

Please replace the paragraph beginning at page 20, line 23, with the following amended paragraph:

When the commutator 63 is rotated in rotation direction as indicated in Fig. 7, the first main brush ~~[[67a.]]~~ 67a, the first sub-brush 67c, and the third sub-brush 67e, which form the first brush group, separate from the short-circuited three of the segments 63a at different times of a predetermined interval. Specifically, the first sub-brush 67c, which has an intermediate resistance, separates from the No. 10 segment 63a when a predetermined time has elapsed since the first main brush 67a, which has a low resistance, separates from the No. 2 segment 63a. Thereafter, the third sub-brush 67e, which has a high resistance, separates from

the No. 18 segment 63a. The second main brush 67b, the second sub-brush 67d, and the fourth sub-brush 67f, which form the second brush group, separate from the short-circuited three of the segments 63a at different times of a predetermined interval. Specifically, the second sub-brush 67d, which has an intermediate resistance, separates from the No. 22 segment 63a when a predetermined time has elapsed since the second main brush 67b, which has a low resistance, separates from the No. 14 segment 63a. Thereafter, the fourth sub-brush 67f, which has a high resistance, separates from the No. 6 segment 63a.

Please replace the paragraph beginning at page 21, line 18, with the following amended paragraph:

As a result, abrasion of the brushes 67a to 67f due to sparks is reduced. This extends the lives of the brushes 67a to 67f, and thus extends the life of the motor. Since the brushes 67a to 67f need not have multi-layered structure with high-resistance portions and low-resistance portions, the cost is reduced. Since the main brushes 67a, 67b have a low resistance, and the first and second sub-brushes 67c, 67d have ~~[[a]]~~ an intermediate resistance, an electrical loss is suppressed. This minimizes a decrease in the power of the motor.

Please replace the paragraph beginning at page 21, line 35, with the following amended paragraph:

As shown in Fig. 8, four supply brushes, or first and second main brushes 68a, 68b, and first and second sub-brushes 68c, 68d, slide on the commutator 55. The width of the sub-brushes 68c, 68d are greater than that of the main brushes 68a, 68b. In this embodiment, the width (effective contacting width) of the main brush 68a, 68b corresponds to ~~the half~~ one-half of the width of each segment 55a, and the width (effective contacting width) of the sub-brushes 68c, 68d is substantially equal to the width of each segment 55a. The main brushes 68a, 68b have a low resistance, and the sub-brushes 68c, 68d have a high resistance. In this

embodiment, the first main brush 68a and the first sub-brush 68c form a first brush group. The second main brush 68b and the second sub-brush 68d form a second brush group.

Please replace the paragraph beginning at page 22, line 15, with the following amended paragraph:

The brushes 68a to 68d are arranged at 90° intervals. Specifically, the second main brush 68b, which is ~~an anode~~ a cathode, is displaced from the first main brush 68a, which is ~~a cathode~~ an anode, by 90° with respect to the rotation direction (rightward as viewed in Fig 8). The first sub-brush 68c, which is an anode, is displaced from the first main brush 68a by 180°. The second sub-brush 68d, which is a cathode, is displaced from the second main brush 68b by 180°.

Please replace the paragraph beginning at page 23, line 8, with the following amended paragraph:

In this embodiment, if the motor (commutator 55) is rotated in either direction, sparks are generated only at the sub-brushes ~~60c, 60d~~ 68c, 68d, which have a high resistance, when the sub-brushes 68c, 68d are separating from the corresponding segments 55a. As a result, without limiting the rotation direction of the motor, abrasion of the brushes 68a to 68d due to sparks is reduced. This extends the lives of the brushes 68a to 68d, and thus extends the life of the motor. Since the brushes 68a to 68d need not have a multi-layered structure with high-resistance portions and low-resistance portions, the cost is reduced. Since the main brushes 68a, 68b have a low resistance, an electrical loss is suppressed. This minimizes a decrease in the power of the motor.

Please replace the paragraph beginning at page 24, line 24, with the following amended paragraph:

The segments 142 are divided into groups of three segments 143 that are spaced by 120° intervals about the axis of the rotary shaft 136. The segments 143 in each group are at the same potential. The three segments 142 in each group are short-circuited with one of the short-circuit lines. The number of the short-circuit lines is eight in this embodiment. Each of the segments ~~[[42]]~~ 142 to which the wires 141 are not connected is connected to ~~[[an]]~~ a middle portion of one of the short-circuit lines.

Please replace the paragraph beginning at page 28, line 31, with the following amended paragraph:

The sub-brushes 144a, 144b are not connected to the power source 146. The wires ~~[[41]]~~ 141 are supplied with electricity from the power source 146 only through the main brushes 143a, 143b. Thus, the sub-brushes 144a, 144b can be designed to have a higher resistance than the main brushes 143a, 143b. Therefore, the resistance of the passages for short-circuiting commutation coils can be increased while maintaining the resistance of the supply brushes low. This improves the commutation. As a result, compared to the motor discussed in the prior art section, which has brushes of a multi-layered structure, the power of the motor 131 is increased.

Please replace the paragraph beginning at page 29, line 32, with the following amended paragraph:

As shown in Fig. 15, wires 154 are wound about teeth 155 by way of concentrated winding and form ~~first to~~ eight excitation coils 162a to 162h. Numerals 1 to 24 are given to the segments 157 shown in Fig. 15 in order along the circumferential direction of the commutator 158.

Please replace the paragraph beginning at page 31, line 22, with the following amended paragraph:

The main brushes 165a, 165b have a low resistance. The sub-brushes 166a, 166b have a resistance higher than that of the main brushes 165a, 165b. The width (the length along the circumference of the commutator 158 (effective contacting width)) of the main brushes 165a, 165b, and the sub-brushes 166a, 166b is substantially equal to that of the segments 157. The height (length in the axial direction of the rotary shaft 136) and the length (the length in the radial direction of the rotary shaft 136) of the sub-brushes 166a, 166b are less than those of the main brushes 165a, 165b. That is, each of the sub-brushes 166a, 166b has ~~[[a]]~~ less volume than each of the main brushes 165a, 165b. The first main brush 165a and the first sub-brush 166a form a first brush group. The second main brush 165b and the second sub-brush 166b form a second brush group.

Please replace the paragraph beginning at page 32, line 3, with the following amended paragraph:

Electric current supplied from the main brush 165a is split into two. One A portion of the current ~~currents-current~~ is supplied to the fourth excitation coil 162d, which is spaced from the first excitation coil 162a by 135°, the seventh excitation coil 162g, which is spaced from the fourth excitation coil 162d by 135°, and the second excitation coil 162b, which is separated from the seventh excitation coil 162g by 135°. The other portion of the current is supplied to the third excitation coil 162c, which is spaced from the sixth excitation coil 162f by 135°, the eighth excitation coil 162h, which is spaced from the third excitation coil 162c by 135°, and the fifth excitation coil 162e, which is separated from the eighth excitation coil 162h by 135°.